MILL SECTION of Concrete

The Cement Mill Edition of Concrete is edited exclusively for those interested in the manufacture of cement. Its pages are devoted to discussions of plant design, management, operation, production efficiency, chemical research and control, quarry operation, progress and news of the industry.

The Cement Mill Edition also contains all the material published in the corresponding Regular Edition and so provides news of the uses and merchandising of the materials whose manufacture is discussed in the Mill Edition. The Regular Section furnishes mill operating officials and mill executives valuable points of contact with the users of the materials they produce.

Volume 38 February, 1931 Number 2

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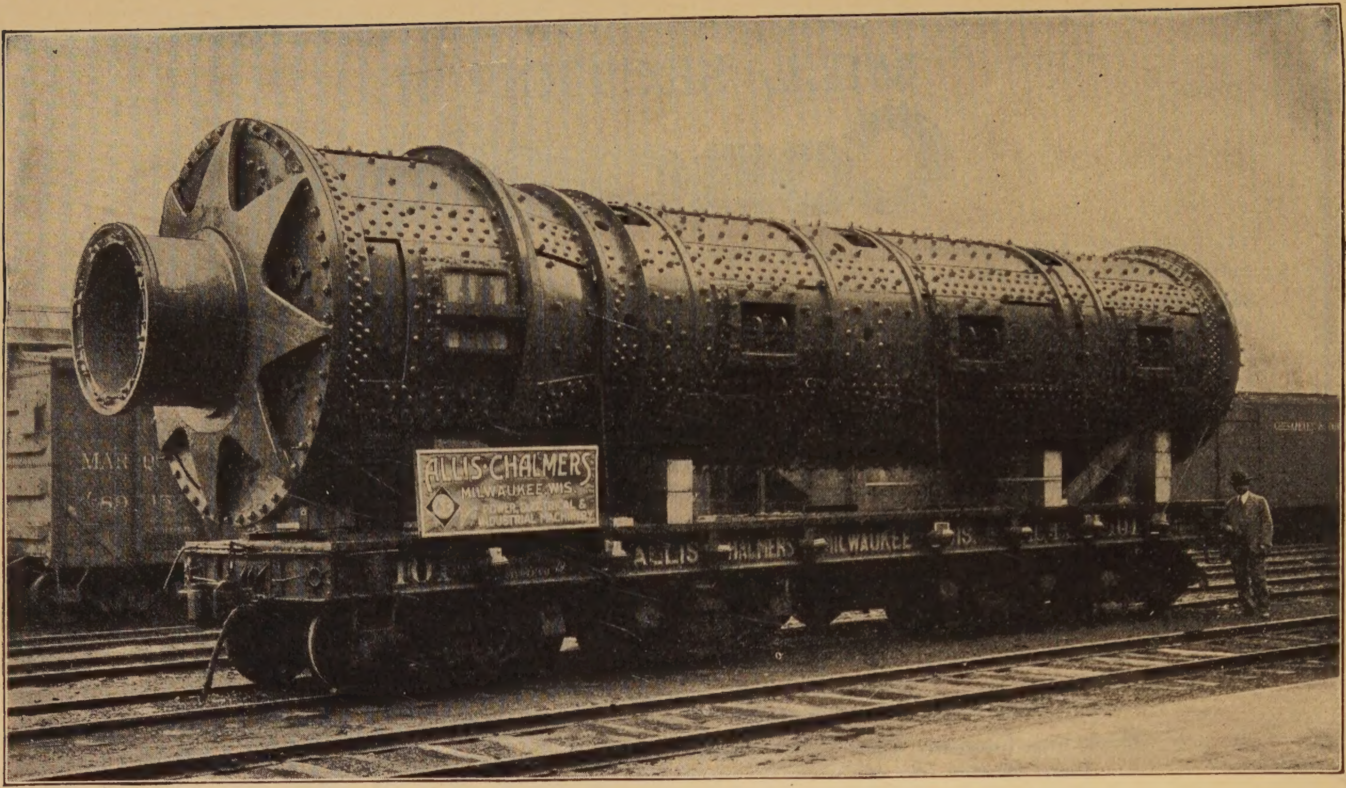
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MILL SECTION of

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Vol. 38 Chicago, February, 1931 No. 2

Constitution of Portland Cement Studied by X-Ray Method

Diffraction Patterns Obtained of 28 Commercial Samples—Results Agree with Chemical and Microscopical Methods—Tricalcium Silicate and Beta Dicalcium Silicate Are Most Abundant Constituents

By L. T. BROWNMILLER and R. H. BOGUE

This is the first part of a paper on the X-Ray Method Applied to a Study of the Constitution of Portland Cement. Publication is approved by the Director of the National Bureau of Standards, U. S. Department of Commerce. Paper No. 24 of the Portland Cement Association Fellowship at the Bureau of Standards.

The remaining part of the paper will be published in the next issue.

THE investigations by Rankin and Wright on the system $CaO\text{-}Al_2O_3\text{-}SiO_2$ have shown that there are formed in that system, at equilibrium, in the region of portland cement clinker, $3CaO.SiO_2$, $2CaO.SiO_2$ and $3CaO.Al_2O_3$. More recently, other systems have been solved, as a result of which the compounds that can be formed at equilibrium, in the region of portland cement clinker, have been determined for the components CaO, Al_2O_3, SiO_2, Fe_2O_3 and MgO. These compounds are $3CaO.SiO_2$, $2CaO.SiO_2$, $3CaO.Al_2O_3$, $4CaO.Al_2O_3.Fe_2O_3$ and MgO.

Portland cement clinker contains, in addition to the above mentioned components, from 2 to 4 per cent of other material, as alkalies, titania, sulphate, manganese oxides, phosphates, etc. These may have some influence on the proportions of the above mentioned compounds in the clinker, but it is improbable that they materially affect the major constitution of the commercial product.

The findings on the five-component system referred to are deduced from studies at the condition of equilibrium. The method used in the manufacture of portland cement leads to the belief that a condition approaching equilibrium is attained in commercial clinker. A failure completely to reach equilibrium, however, may result in the presence of some uncombined lime and a change in the relative proportions of the other compounds, but rarely in the elimination of one of those compounds, with the formation of a different compound.

Investigations have been reported from this laboratory which confirm this viewpoint. The methods used in the study of phase equilibria, including thermal, microscopic and X-ray examinations, have indicated that the major compounds of portland cement clinker are $3CaO.SiO_2$, $\beta 2CaO.SiO_2$, $3CaO.Al_2O_3$, $4CaO.Al_2O_3.Fe_2O_3$ and MgO.

Many investigators, however, especially in Europe, have adhered to theories of constitution developed prior to the application of the phase rule, or have advanced other views which are at variance with those expressed above. Prominent among these may be mentioned the view that the lime, in excess of that necessary to form $2CaO.SiO_2$ with the silica, enters essentially into solid solution with the $2CaO.SiO_2$; the contention that $3CaO.SiO_2$ does not exist and that the principal constituent of clinker is $8CaO.Al_2O_3.2SiO_2$; the opinion that the $3CaO.Al_2O_3$ enters into solid solution with the calcium silicates; and the conclusion that portland cement clinker contains relatively large amounts of uncombined lime.

The X-ray method is peculiarly well adapted to the examination of the above theories, both as they apply in pure systems and in commercial clinkers. This was one of the objectives of this research: to present X-ray evidence bearing directly on each of the above theories to the end that the nature of the compounds in the pure systems and in commercial cement clinker may become generally established.

The second purpose of this study was to examine by X-ray and chemical means a large number of commercial clinkers to ascertain, (1), precisely what compounds could be positively identified in each and, (2), the nature of the agreement between such X-ray analysis and the constitution as computed from the chemical analysis. Incidental to this part of the work, it was necessary to determine the efficiency of the X-ray method to resolve the pattern of each compound in the presence of the other compounds of the cement.

The X-Ray Method

The positive identification of a crystalline compound by the microscope should include the measurement of a number of the optical properties, such as the refractive indices, optic axial angle, pleochroism, etc. But in the case of portland cement it is not possible to obtain all of these data for each phase present. The crystals, even of the principal constituents, usually are very finely grained and often too small to permit of satisfactory measurements. Furthermore, the crystals often are surrounded with glass or contain inclusions. For these reasons the microscopic examination of these materials has not proved entirely satisfactory and this condition has resulted in much difference of opinion in the interpretation of the available observations. The X-ray method therefore fills a distinct need, for the results obtained with it are based on criteria which are convincing.

During recent years the powder X-ray method for identifying compounds in the pure state or in mixtures has received considerable attention and development. The theoretical considerations of this method have been described in various places. When a powdered material is subjected to X-radiation and the resulting spectrum photographed, there is obtained an X-ray diffraction pattern consisting of a series of lines in definite positions which are ordinarily measured from a fixed zero point and recorded as "interplanar spacings," ($dhkl$). Each crystalline chemical compound has a characteristic diffraction pattern which appears always to be the same whether the compound is present in a pure state or intermixed with other compounds. Even different crystalline forms of the same composition can be distinguished by the method; thus γ and $\beta 2CaO.SiO_2$ have entirely different diffraction patterns.[1]

The X-ray method has definite but well understood limitations. Thus, a diffraction pattern depends on the arrangement of the atoms of a substance in crystal planes. Glass shows no such arrangement and hence cannot be detected by the method.

In a mixture of two compounds, it often happens that some of the lines of one pattern coincide with some of the lines of the other pattern. Hence, the greater the number of compounds, the greater the probability of coincidence of lines. Nevertheless such coincidences cause differences in intensity of the resulting lines so that the identity of a pattern may not be entirely obscured.

Of greater significance are the limitations due to the amount of a material present. As the quantity of one crystalline phase decreases, the general intensity of the pattern of that compound decreases. First the least intense lines of the pattern disappear and then the stronger lines until a certain minimum amount of the compound is reached when the strongest lines can no longer be observed. Under the most favorable conditions, quantities of material less than 2 or 3 per cent of the total can rarely be identified. For the detection of such small amounts of material, the crystals should be well-developed, possess a high order of symmetry and a simple structure and give rise to lines which do not conflict with those of the patterns of the other materials present. Only infrequently are these conditions fulfilled so that, ordinarily, greater amounts than those mentioned above are required for the recognition of a phase.

The relative intensities of the lines as well as their positions are significant in the identification of compounds. If one line of a diffraction pattern is twice as intense as another line of the same pattern, that relation obtains whether the compound is present in a pure state or in a mixture. In a mixture of two compounds, the pattern of one is superimposed on that of the other; the general intensity of each pattern is diminished because of dilution by the other, but the relative intensities of the lines of each pattern remain the same.

Analysis of a sample of an unknown material therefore depends upon the recognition, by position and relative intensity, of the lines of the diffraction pattern of a pure material in that of the unknown sample. Hence, before any such analysis can be undertaken, the diffraction patterns of the pure compounds which may occur in the sample must be known. Such information has been published from this laboratory for most of the pure compounds which occur in the oxide systems of portland cement.[2]

Recent improvements in methods and purity of samples have resulted in somewhat more precise measurement of the lines of the diffraction patterns and in more complete diffraction data, but the interplanar spacings are not found to differ essentially from those reported previously.

The apparatus used in this study was the X-ray diffraction photometer of Hull equipped with a Coolidge molybdenum water-cooled target. The cassettes for holding the films were provided with zirconium oxide filters so that the effective wave length of the rays was 0.712 A. U. The radius of the cassettes was 8 inches. Since crystals of clinker are extremely small, the powder method of Debye and Hull was found most suitable and was used exclusively in these studies. By this method the samples of clinker are ground to pass a No. 200 sieve and mounted in lead-free glass tubes of about 0.5 mm. inside diameter. Occasionally the samples were mounted on a silk thread. To do so the finely ground clinker was mixed with collodion and the thread immersed. On withdrawing the thread, sufficient material adhered to permit a satisfactory analysis. Exposure of a sample lasted 50 hours in most cases at a tube current of about 18 milliamperes and a voltage of 30,000.

Diffraction patterns were obtained of 28 samples of clinker, both domestic and foreign. For the complete analysis of any one sample, several exposures were necessary. Normal exposure of 50 hours was sufficient for the identification of most of the lines; occasionally, however, over-exposure and over-development of the films were resorted to for the strengthening of the weaker lines. On the other hand, underexposure and underdevelopment sometimes provided a means for the resolution of two lines lying very close to each other, which lines ordinarily merged to form one broad band. In the identification of the patterns of various pure compounds in clinker a capillary tube was filled one-half of its length with the samples of clinker and the other half with the compound to be identified. Thereby the patterns of the two were exactly opposite each other on the film and measurement of the lines became more precise since then irregularities of two films were avoided. Altogether some 200 exposures were made in the course of this study.

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[1] W. C. Hansen, *Jour. Am. Ceram. Soc.*, 11 (1928), 68.

[2] F. A. Harrington, *Amer. Jour. of Science*, 13 (1927), 467.

The precision of measurement of the interplanar spacing increases as the interplanar spacing decreases. It may be pointed out, however, that weak lines are more difficult to estimate than stronger lines so that measurement in such cases may not be as accurate; often also they lie close to strong lines so that their true position may be misjudged. Measurements were made on the centers of the lines but in some cases, where a line is broad, the precise allocation of the center is difficult. Many of these broad lines may be found, by special exposures, to consist of two lines. Where such lines occur in the patterns, the position of each component line is recorded in the following tables, together with the reading that ordinarily is obtained where the two lines appear as one broad band.

In order to determine the relative precision of the measurements of the interplanar spacings, fifteen films of the diffraction patterns of tricalcium aluminate were examined. Six lines in each film were measured. A summary of the results is given in Table I. It may be noted that the difference between the extreme values as measured diminish from .020 at interplanar spacings of 2.690 to .004 at interplanar spacings of 1.202. The average deviations from the mean through the same range diminish from .004 to .001. This serves as a general indication of the precision of measurements in this study, but some variation may occur due to the differences in sharpness or intensity of the lines as above noted.

TABLE I

The Precision of Measurement of Six Lines in the X-ray Diffraction Pattern of $3CaO.Al_2O_3$

	Line Number					
	1	2	3	4	5	6
Mean (15 films)	2.690	2.202	1.905	1.555	1.346	1.202
Maximum value	2.700	2.210	1.910	1.557	1.348	1.205
Minimum value	2.680	2.195	1.897	1.551	1.344	1.201
Difference between extreme values	.020	.015	.013	.006	.004	.004
Av. deviation from mean	.004	.004	.003	.002	.001	.001

The intensity of the lines was measured visually. This is the procedure commonly employed and is satisfactory for qualitative observations. A photodensitometer has been developed in this laboratory, however, for the more precise estimation of the intensities of the lines which will be employed in a later study on the quantitative X-ray determination of the compounds present.

The Composition

$3CaO + SiO_2$

The existence of $3CaO.SiO_2$ in the $CaO\text{-}Al_2O_3\text{-}SiO_2$ system and in portland cement clinker has been established by phase equilibria studies combined with microscopic examinations. A number of European investigators, however, have been unable to accept the existence of that compound, and the suggestion has been urged that the lime enters into solid solution with dicalcium silicate. The evidence obtained by the X-ray method on this problem is important because of the rigid nature of the criteria in the identification of compounds in the X-ray diffraction patterns. These data, set down below, offer impressive confirmation of the existence of the tricalcium silicate in the $CaO\text{-}Al_2O_3\text{-}SiO_2$ system and in portland cement clinker.

Samples were prepared of the following compositions:

No. 1	$2CaO + SiO_2$
No. 2	$2\frac{1}{3}CaO + SiO_2$
No. 3	$2\frac{1}{2}CaO + SiO_2$
No. 4	$2\frac{3}{4}CaO + SiO_2$
No. 5	$3CaO + SiO_2$

These were made from calcium carbonate and quartz of high purity as indicated by the partial analyses[3] of these materials given in Table II.

The weighed portions of sample No. 1 ($2CaO + SiO_2$), ground to pass completely through the No. 200 sieve, were mixed in a pebble mill for three hours, then formed into bars about 10 inches long by 1 inch cross section and heated in an updraft gas furnace for $2\frac{1}{2}$ hours at 1500 deg. C. The clinker was ground and a sample taken for microscopic and X-ray examination and for the free CaO test. The balance of the sample was then mixed in the pebble mill as before with an additional quantity of calcium carbonate to give the composition of No. 2 ($2\frac{1}{3}$ $CaO + SiO_2$), and the mixture again burned for $2\frac{1}{2}$ hours at 1500 deg. C. This process was repeated with additional increments of calcium carbonate until all of the samples of the different compositions had been obtained. The free CaO test showed that no lime remained uncombined in any of the samples.

TABLE II

Partial Analyses of Raw Materials

	Calcium Carbonate	Quartz
CaO	55.55	0.02
MgO	0.07	0.00
SiO_2	0.03	99.37
Al_2O_3	0.01	0.50
Fe_2O_3	0.00	0.03
Cl	0.04	0.00
SO_3	0.00	0.00
CO_2	43.63	-----
Loss in ignition	43.97	0.11

Each of the samples was subjected to X-radiation and the diffraction patterns obtained. No. 1 showed only the pattern of $\gamma 2CaO.SiO_2$. No. 2 showed the lines of a new pattern, which we will call x, superimposed upon that of $\gamma 2CaO.SiO_2$. In No. 3, the lines of $\gamma 2CaO.SiO_2$ disappeared and were replaced by the pattern of the beta form of that compound. The pattern of x also was present, and in greater intensity than in No. 2. No. 4 showed the same pattern as No. 3 except that the lines of $\beta 2CaO.SiO_2$ were weaker and the lines of x were stronger. No. 5 showed only the pattern of x. In no case were the lines of CaO observed nor was there found any shift in position of the lines of the dicalcium silicate nor of x following a change in composition.

The formation of a distinctive pattern when the composition $3CaO + SiO_2$ is reached, together with the appearance and position of this pattern in other mixtures, meets the requirements for assigning to that composition an identity as the chemical compound $3CaO.SiO_2$. When larger amounts of CaO are present than represented by

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[3] Analysis by H. C. Stecker.

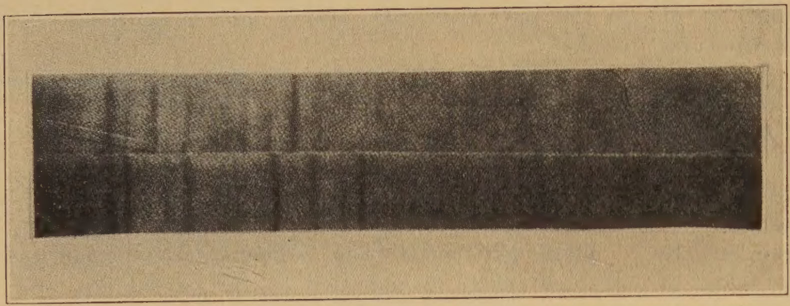

Figure 1. Upper: Pattern of equimolar mixture of $\beta 2CaO.SiO_2$ and CaO Lower: Pattern of pure $3CaO.SiO_2$

the composition $3CaO + SiO_2$ the pattern of CaO is found to be superimposed upon that of the $3CaO.SiO_2$. Between the compositions $3CaO + SiO_2$ and $2CaO + SiO_2$ there always are observed the lines of $3CaO.SiO_2$ and β or γ $2CaO.SiO_2$. The intensities of the two patterns are proportional to the calculated amounts of those compounds that should be present. When sufficient attention is given in the preparation to insure that a condition of equilibrium is reached, the lines of CaO are absent. The failure to observe any shift in position of the lines of those compounds when CaO is added indicates that no solid solution is formed or that the amount of such solution, if there is any at all, is too small to be detected.

The principal interplanar spacings of the patterns of CaO, $3CaO.SiO_2$, and $\beta 2CaO.SiO_2$ are listed in Table III. An inspection of the data will show that the pattern of each is distinctive. There are, indeed, several lines which are found to be coincident in two or three of the patterns, but a sufficient dissimilarity is found, both in position and intensity of lines, definitely to preclude any interpretation which would assign to tricalcium silicate the composition of a mixture or solid solution of the other two compounds.

Recently Janecke[4] has interpreted X-ray data reported from this laboratory[1] as indicating that $3CaO.SiO_2$ is a mixture of $\beta 2CaO.SiO_2$ and CaO. In order the better to demonstrate that the pattern of $3CaO.SiO_2$ is quite distinct from that of $\beta 2CaO.SiO_2$ with CaO, X-ray diffraction photographs were made as follows: One half of a capillary glass tube for exposure was filled with pure tricalcium silicate; the other half was filled with an equimolar mixture of beta dicalcium silicate and calcium oxide. The resulting photograph shows the patterns of the two materials on opposite sides of the same film. X-ray diffraction patterns do not reproduce well for printing, but the reproduction shown in Fig. 1 reveals the striking dissimilarity of the two patterns. The upper pattern is that of the mixture of $\beta 2CaO.SiO_2$ and CaO. The lower pattern is that of pure $3CaO.SiO_2$. It is at once apparent that $3CaO.SiO_2$ is not composed of $\beta 2CaO.SiO_2 + CaO$.

A careful measurement of the interplanar spacings shows that the mixture of $\beta 2CaO.SiO_2$ and CaO gives a superimposed pattern of those two compounds. It conforms to a combination of the patterns of those compounds as listed in Table III. The pattern for the $3CaO.SiO_2$ is identical with that listed for $3CaO.SiO_2$ in Table III.

The Composition
$8CaO + Al_2O_3 + 2SiO_2$

In 1912 Janecke published his first paper setting forth his discovery that the "alite," or principal compound of

TABLE III

The Principal Interplanar Spacings of CaO, $3CaO.SiO_2$ and $\beta 2CaO.SiO_2$.*

Line No.	CaO	$3CaO.SiO_2$		$\beta 2CaO.SiO_2$	
1				3.80 w	
2				3.37 w	
3		3.02 s		3.03 wb	
4		2.940 w			
5				2.870 w	
6	2.765 m	2.770 ss	2.750	2.780 ss	2.750
		2.730 ss		2.730 ss	
7		2.600 s		2.610 s	
8				2.540 w	
9		2.435 ww		2.440 m	2.420
				2.400 m	
10	2.390 ss				
11		2.320 m			
12				2.278 m	
13		2.178 s		2.182 s	
14				2.080 w	
15				2.040 w	2.030
				2.020 w	
16		1.975 m		1.980 m	
17		1.932 m			
18				1.895 m-b	
19		1.825 w			
20				1.800 m	
21		1.762 s			
22				1.755 w	
23				1.700 wb	
24	1.695 s				
25		1.627 s		1.632 w	1.620
26				1.610 w	
27				1.575 ww	
28		1.542 m-b		1.548 ww	
29				1.528 w	
30		1.487 s		1.482 w	
31		1.458 w			
32	1.445 m			1.447 ww	
33				1.415 w	
34	1.385 m	1.390 ww		1.393 ww	
35				1.370 w	
36		1.198 w			
37		1.162 wb			
38		1.132 wb			
39		1.090 wb			
40	1.075 m				
41		1.020 wwb			
42	.980 m				

*In this and in subsequent Tables, ss = very strong; s = strong; m = medium; w = weak; ww = very weak; b = broad.

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[4] E. Janecke, *Zement* 18 (1929), 1345.

portland cement, consists of $8CaO.Al_2O_3.2SiO_2$. This contribution was quickly refuted by Rankin and Wright,[5] who pointed out that such a compound did not exist in the $CaO\text{-}Al_2O_3\text{-}SiO_2$ system, and that a mixture of that composition at equilibrium consists of $3CaO.SiO_2$, $2CaO.SiO_2$ and $3CaO.Al_2O_3$. The conclusion of Rankin and Wright has been confirmed in this laboratory[6] but the existence of $8CaO.Al_2O_3.2SiO_2$, designated "Janeckite,"[7] as the "alite" of portland cement clinker, has been reaffirmed by Janecke.[8]

The X-ray evidence upon which the opinion of this laboratory is based is set down below:

The purported composition $8CaO.Al_2O_3.2SiO_2$ was prepared[6] in the form of fused drops by the method described by Dyckerhoff and found by microscopical examination to consist largely of the elongated fiber-like crystals said to be characteristic of that compound. The drops were crushed and examined by the X-ray method; at the same time a mechanical mixture of $3CaO.SiO_2$, $\beta 2CaO.SiO_2$ and $3CaO.Al_2O_3$ in the same molecular proportion was subjected to X-radiation.

The X-ray data on these materials are given in Table IV, together with the pattern of CaO which was found also to be present in the fused drops.

The X-ray pattern of the fused drops is observed to be similar to the pattern of the mechanical mixture of $3CaO.SiO_2$, $\beta 2CaO.SiO_2$ and $3CaO.Al_2O_3$ except that a few additional lines appear in the former which may be noted to be due to free CaO.

In a recent paper, Janecke[9] presents some information obtained by the X-ray examination of the composition "$8CaO.Al_2O_3.SiO_2$." In the pattern of that composition, Janecke reports that he finds the lines of $\beta 2CaO.SiO_2$, $3CaO.Al_2O_3$ and CaO together with a few additional lines which he ascribed to "Janeckite." Unfortunately he makes no attempt at a comparison of those lines with the pattern of tricalcium silicate.

From the evidence presented it appears that Janecke's compound is a mixture of $3CaO.SiO_2$, $\beta 2CaO.SiO_2$ and $3CaO.Al_2O_3$ with a small amount of CaO.

TABLE IV

Interplanar Spacings of the $8CaO + Al_2O_3 + 2SiO_2$ Preparations, Mixtures of $3CaO.SiO_2$, $\beta 2CaO.SiO_2$ and $3CaO.Al_2O_3$ and of CaO

Line No.	Fused drops of $8CaO + Al_2O_3 + 2SiO_2$	Mixture of C_3S, βC_2S and C_3A	CaO	Compounds giving rise to lines in pattern of fused drops
1	3.03 m	3.03 m		C_3S
2	2.77 ss	2.77 ss	2.765 m	C_3S, βC_2S, CaO
3	2.69 ss	2.69 ss		C_3A
4	2.60 m	2.60 m		C_3S
5	2.39 m		2.390 ss	CaO
6	2.27 ww	2.26 ww		βC_2S
7	2.18 s	2.18 s		C_3S, βC_2S, C_3A
8	2.03 ww	2.04 ww		βC_2S, C_3A
9	1.975 w	1.970 w		C_3S, C_3A
10	1.895 s	1.895 s		C_3A
11	1.755 m	1.758 m		C_3S
12	1.695 m		1.695 s	CaO
13	1.627 m	1.630 w		C_3S, βC_2S
14	1.550 s	1.552 s		C_3A
15	1.483 m	1.485 w		C_3S
16	1.450 w		1.445 m	CaO
17	1.385 ww		1.385 m	CaO
18	1.345 w	1.342 w		C_3A
19	1.200 m	1.202 m	1.201 w	C_3A, CaO
20	1.095 w	1.093 ww	1.101 w	C_3S, CaO
21	1.076 ww		1.075 m	CaO
22	1.020 w	1.017 w		C_3A
23	0.980 ww		0.980 m	CaO
24	0.900 ww	0.896 ww		C_3A

Note: $C_3S = 3CaO.SiO_2$
$C_2S = 2CaO.SiO_2$
$C_3A = 3CaO.Al_2O_3$

Peerless Urges Michigan Legislators to Abandon State Plant

A letter reported sent to each Michigan state legislator by the Peerless Cement Company asks that the Chelsea state cement plant be discontinued and that "this property be disposed of to wipe off as much as possible of the $700,000 deficit charged against the plant.

The letter, signed by William M. Hatch, president, charges that the state plant lost more than 12 cents a barrel on cement produced during the past year, but in spite of this fact, more than 500,000 barrels were turned out and used in state highway construction. The net loss to the taxpayers as a result of operating the plant during the past 12 months, it continues, was more than $100,000.

Canada Cement Profit in 1930 Almost Equals That in 1929

Annual statement of Canada Cement Company, for 12 months ended November 30, 1930, reveals that the company had a good year despite general business depression in the Dominion. Increase in valuation of fixed assets, by nearly $1,000,000 from last year, reflects plant expansion during the period. At same time, working capital is shown at approximately the same level as in 1929, and earning are reported only slightly below those of last year.

Company reports operating profit for the 12 months of $3,132,150, against $3,171,115 the year before.

Canada Cement's Port Colborne Plant Changing from Dry to Wet

The second of the Canada Cement Company plants—No. 8, at Port Colborne, Ontario—is being changed from the dry process to the wet process. The new equipment to be installed in connection with the change includes a rotary kiln 420 ft. long with a cooler and chain system, and a raw mill with complete agitator equipment.

Orders for the new equipment have been placed with F. L. Smidth & Company of Canada, Ltd., of Montreal.

Kansas Plant of Universal Atlas Resumes Operation

The Universal Atlas Cement Company plant at Independence, Kansas, reopened early in January, after being shut down for about a month.

According to C. M. Carman, extent of operation the past year has been almost up to normal and a better demand is anticipated during 1931.

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Marketing Company Sells India's Cement

Indian Cement Manufacturers Stabilize Price and Production—Marketing Organization in Successful Operation Since 1925—Outline of the Selling Plan

By **WALTER BUCHLER**
Bombay, India

IN 1924 a rate war occurred between all the portland cement producing companies in India (at that time seven in number), and it brought little benefit to the trade in general. The result was that an association, called the Indian Cement Association, was shortly afterward formed which stabilized prices, each company continuing to sell its products in the territory it covered.

Form Single Marketing Company

Subsequently, the Indian cement manufacturers took a step forward and formed a marketing organization (called the Cement Marketing Company of India, Ltd.) to regulate the output for each company and to effect economy in distributing charges by supplying, as far as possible, the various markets from the nearest works.

The cement is sold on the basis of brands. It is sold f.o.b. cars and the price ranges from rupees 50 to rupees 60 per ton (2,240 lbs.), according to the locality of the factory. Each company pays for a railway booking clerk, who is attached to the works staff, and it is his task to check all the contents of freight cars carrying cement and seal them before despatch.

Marketing Organization Handles All Orders

All orders come through this marketing company, which allocates them to the nearest works, and it is its duty to see that each company obtains its correct quota in the year, based on its output. Quotas of all manufacturers are based on the same percentage of their output. If, for example, the demand is 80 per cent of the manufacturing capacity, then each will get 80 per cent of its individual manufacturing capacity.

The system of marketing cement in India can be stated briefly. Agents, who are usually large firms of merchants, are appointed for different population centers of India. They sell at the prices fixed by the Cement Marketing Company, and these have been stable ever since the organization was formed in 1925. The agents are allowed a commission of 5 per cent. Any cutting of commissions is discouraged. Nevertheless, cases of this nature do occur, and agents are warned if found out. Should they persist, they lose the agency. Agents buy by carloads, receiving 40 to 60 days credit, and sell to stockists, who are appointed by them to cover certain areas. Every town in India has a "stockist" of cement and he in turn sells to smaller dealers, contractors, and other persons using cement.

The larger building contractors usually buy direct from the nearest agent, thereby saving from 4 to 10 per cent in the price, which is the usual profit of the dealer, the rate varying according to his overhead expenses. The average dealer handling cement in India, as a rule, handles also other kinds of building materials, including hardware.

Stocks Carried

The method of stocking varies according to locality. In Bombay agents keep practically no stocks, but have carloads of cement (from three to five) arriving every day. These are immediately cleared by customers, thereby saving the cost of renting large warehouses to store the cement. In Calcutta cement agents hold stocks of a thousand tons or more and deliver from them to dealers as required. In the Punjab, where quite a large business is done by buyers direct with the cement works themselves, the buyers go to the factory and collect the cement in bullock carts, in this way effecting a saving in transport costs (the railway freight being paid by the buyer if so

A scene in India, showing natives building concrete work shipped). This is only practicable where there are good roads, as in the Punjab.

The Cement Marketing Company has sales supervisors traveling around the country all the time, keeping in touch with agents, and through them with any important construction work planned or in progress. Generally, the agent accompanies the sales supervisor, who may be either a European or an Indian employed by the marketing company on a salary basis, full time, interviewing contractors, engineers and architects to ascertain what business prospects are and to give advice where needed. The agent keeps the sales supervisor in his area continually informed of developments and sales, and the latter makes reports to his principals in Bombay at regular intervals.

Both the Indian and European agents are generally very active in promoting sales of cement in India in their different areas. It is a fact that the Indian cement merchant is more active than the dealer handling other commodities. The reason for this probably lies in cement being both easy and profitable to handle, with sales steadily increasing from year to year. In 1924 the sales were 275,000 tons, increasing in 1930 to more than 600,000 tons. The sales season for cement is from November to June, the peak off-take being in March and April. Sales fall off during the monsoon, which is the rainy season in India, lasting from June to September, during which time all construction work ceases on account of the heavy downpours of rain.

Finding Undeveloped Sources of Fuel for Cement Plants

Low-Grade Fuels Combined with Usual Grades of Pulverized Coal Reduce Burning Costs—May Find Supply Close at Hand—Careful Analysis Required

By E. T. ELLIS, F. J. I.
Ecclesall, Sheffield, England

This is the first of a series of articles intended to draw the attention of cement companies to certain so-called low grade fuels which are apt to be overlooked, but which can, if manipulated in certain easy ways, be utilized advantageously for burning, either alone or combined with the coal and other materials usually employed.

There are a great many of these materials, and they vary widely in different parts of the world. Their compositions vary almost as greatly as their names do, but analyses in many instances are available, and by examining these in conjunction with the materials themselves it is possible to judge whether any offer of such materials should be declined, or whether it should be accepted.—The Editors.

VERY often there are dumps of so-called low grade fuels comparatively close at hand. If examination of a fair sample shows that it is not below the fixed carbon content of any of those mentioned in this article, arrangements might well be made to buy the whole dump.

The use of low grade fuels in cement factories can greatly reduce the cost of cement. It is obvious that if 50 per cent of a cheap material is added to the usual supply, the cost of burning will be much less. Cement producers, however, should not go to the other extreme and buy up every carbonaceous waste product they can lay their hands upon, as I shall draw attention again and again as the series proceeds to materials which are far too costly for manipulation as fuel for cement factories; that is, the manipulative processes they require will cost more than better grade fuel would cost if bought in the ordinary way.

Anthracite Culm

First of all I would like to draw the attention of cement manufacturers to a so-called low grade fuel mainly known as anthracite culm. Most samples of this form an excellent fuel for cement factories if manipulated as described below, provided that they are mixed with a fair proportion of recognized fuel, which is usually small coal or coke. Firing of the two is done together after fine grinding.

The best samples of anthracite culm for employment as fuel in cement factories should show on analysis 65 per cent of fixed carbon and at least 12 per cent of volatile matter. The ash content, unfortunately, is often considerable; but all samples containing more than 21 per cent of ash should be respectfully declined, as they are technically unsuitable. The moisture content is usually low, and cement firms should specify that it should be very small. About 2 per cent of moisture may be permitted, and a fuel of the above composition then has an approximate calorific value of 11,300 British thermal units.

The modus operandi or method of exploiting anthracite culm as fuel for cement factories consists first of all of passing it along an endless band arrangement, on both sides of which youths should stand with stirring stakes. Pieces of stone, anthracite shale, etc., are largely thrown onto the top by this means, and can be picked off by youths farther on. Air drying is hardly called for with anthracite culm which contains as little as 2 per cent of moisture, and the cement plant management need not, therefore, go to that trouble. Following examination on the band this anthracite culm should be at once mixed with small coal or coke breeze to be used in the cement factory, the proportions being fifty-fifty, and after fine grinding has been done firing without further treatment can be carried out.

Anthracite Slush or Silt

Not much need be said concerning this material as fuel for cement factories, since much of it is too wet, and too finely divided for successful employment. Most samples of the slush or silt will, when dry, pass through circular sieve holes measuring only three thirty-seconds of an inch in diameter, and the amount of dirt (incombustible matter) which is frequently present is often enormous.

The best samples, however, of anthracite slush or silt when properly dried yield 10,000 British thermal units per pound of dry coal. In this connection they compare very favorably with anthracite culm, but I would always go for the former rather than the latter, as a great amount of moisture must usually be removed from anthracite slush or silt before it can be successfully employed, which obviously costs cement plant managers a lot of money.

"Batts" from Coal Cleaning Dumps

Cement works managers who operate in colliery districts may like to purchase batts from coal cleaning dumps for use as fuel for their cement factories. That this is often wise needs little emphasis, but that it is frequently unwise must be pointed out as well. Cement technologists who are unfamiliar with buying batts should remember that each 230 tons of fresh batts should yield at least 120 tons of usable nuts. In a great many instances, however, as cement experts will find, samples of batts offered by collieries will not conform to this test, but will yield under 100 tons instead of 120. This means that an enormous amount of dirt and stone has to be removed before the batts can be successfully exploited as a source of fuel for cement factories, and such poor samples should be declined.

Many analyses have been made of batts from coal cleaning dumps, and in the case of unwashed samples, cement companies will frequently be offered those which contain not more than 7 per cent of moisture, and as much as 52 per cent of ash or incombustible matter. Unwashed samples will also be offered which show on analysis the presence of at least 19 per cent of volatile matter, which is advantageous, and carbon in a fixed state amounting to as small a quantity as 23 per cent.

As cement executives will expect, samples of this kind are not much use for employment as fuel for cement factories. It is, however, possible and in some cases quite easy to reduce the moisture content by a small amount, to reduce the ash percentage very largely, and consequently to increase the percentage both of volatile matter and fixed carbon up to points which enable this fuel to compete with many of the others.

The best washed and dried samples of batts from coal cleaning dumps make very fair fuels for cement factories, and these should show a moisture content of not more than 5 per cent and an ash content of certainly not more than 25 per cent, while in many instances a percentage below 20 is possible. The volatile matter content of these washed and dried samples should, if they are to be successfully employed in the cement factories, be around about 29 per cent, while analysis should reveal the presence of carbon in a fixed state amounting to at least 41 per cent.

The modus operandi in this instance consists of still further air-drying the already washed and dried batts, and passing the material along an endless band arrangement so that lumps of mineral matter of a non-carbonaceous character can be picked out, so as to keep the ash content as low as possible. Following this the batts should be pulverized to bring them to nut form, and the nuts again passed over the endless band prior to being mixed with small coal, coke, etc., and ground together for firing in cement factories.

Colliery Slurry

Cement concerns who are on the lookout for cheap fuel will be certain to have their attention called to samples of colliery slurry. In some instances this can be exploited successfully as fuel for cement factories, and in other instances it is far better to leave it severely alone.

Poor samples of colliery slurry yield on analysis only 37 per cent of fixed carbon, and only 13 per cent of volatile matter. On the other hand, these poor samples of colliery slurry frequently contain as much as 19 per cent of ash, and the huge proportion of 28 per cent of moisture.

The calorific value of the worst samples of colliery slurry is about 6,000 B.t.u., and sometimes less. It will, therefore, be seen that cement producers who buy samples must do something to make them suitable, or indeed reasonably safe, for employment as fuel.

While samples of colliery slurry of the above composition should be declined at once, there are others on the market which are very different in character. Analysis of some of these reveals the presence of 49 per cent of fixed carbon, while the content of volatile matter is roughly 19 per cent, as compared with 13 per cent in the worst forms. Then again the ash content, instead of being 19 per cent, is only 9 per cent. The moisture, although still high, amounting as it generally does to about 21 per cent, can be greatly reduced by air drying. The calorific value of these forms of colliery slurry is then roughly 9,000 B.t.u., which is very different from that of the other form.

The modus operandi consists, as will be expected, of treating this colliery slurry in air driers, in order to reduce its moisture content very substantially, this being the first step. It is useless to do anything else with the moisture as high as 21 per cent. Following this, however, passage along an endless band arrangement is essential, as by this means small pieces of rock, shale, etc., which have found their way into the slurry can be readily removed by hand. The ash content is sometimes reduced by this means to as low as 5 per cent. In some instances riddling of the dried concentrated colliery slurry is advisable, so that fine material may pass out for independent treatment and the coarser stuff can be re-passed over the endless band for further examination, in order to reduce its content of incombustible matter to still less. Direct admixture of the concentrated colliery slurry with small coal, coke, etc., ordinarily used as fuel for cement factories is advisable, about 50 per cent of each being recommended by some authorities; but I prefer to advise less of the slurry, and consider 25 per cent of it sufficient.

Colliery Smudge

Another low grade or so-called low grade fuel which cement firms who are on the lookout for cheap combustibles will be certain to be offered is found in colliery smudge, which goes under a variety of different names in various parts of the world. Some samples of this are practically useless, and in order that cement mill men may not be enticed into buying it, with disastrous results, the following points should be carefully noted.

The useless samples of colliery smudge so far as fuel for cement factories is concerned contain as low a proportion of fixed carbon as 27 per cent. The volatile matter content is also very low, being below that of colliery slurry, and frequently only 11 per cent. The ash content is above that of the poorest samples of colliery slurry, and may usually be reckoned to be 25 per cent in worthless samples, though often it is more. The moisture content is slightly lower than that of the worst samples of colliery slurry, but may usually be reckoned to be 21 per cent in declinable samples. The calorific value of samples of this smudge, which should not be employed for fuel for cement factories, is usually around 6,000 British thermal units, approximately the same as that of colliery slurry. Frequently, however, it is lower.

Turning now to those samples of colliery smudge which can, and which indeed should, be made some use of as fuel for cement factories, parcels can from time to time be picked up on the market showing a fixed carbon content of 55 per cent, which is considerably more than that noticed in good samples of colliery slurry. Then as regards the volatile matter content, there are again parcels which can be picked up, if one makes a special effort to do so, which show 22 per cent of this, which is a very different proposition from 11 per cent. As regards the ash content, this is always high; but cement plant managers who buy colliery smudge for use as fuel in their factories should specify that it should never exceed 23 per cent, as even then pretty elaborate treatment is necessary to reduce it to a workable figure. The moisture content, however, shows the greatest difference of all. The best samples of colliery smudge for use as fuel in cement factories should contain only 5 per cent of moisture, and this should be possible of still further reduction by an ordinary air drying plant. With such a composition the calorific value should be 9,500 B.t.u., while in some samples tests show a value of 10,000.

The modus operandi consists of air-drying the colliery smudge, so as to reduce its moisture content to 2 per cent if possible, following which very elaborate treatment on endless bands is almost essential in order to reduce the ash content. Bands operating in troughs give the best results in the first instance, so that the colliery smudge can be repeatedly stirred up by youths armed with small spades or forks. By this means pieces of stone, pieces of shale, and other refuse known to be entirely worthless from the combustion point of view can be picked out farther on. Arrangements should usually be made for the once picked material to pass over a lower band in a trough so that it can be stirred up a second time, as the material is far too poor to be passed over the bands in the thin layers that ordinary fuels are. By such second treatment, however, further stone, incombustible shale, etc., will be got rid of, and it should be possible to reduce the ash content to 10 or 12 per cent.

Following this the concentrated colliery smudge should at once be mixed with about three times its own bulk of ordinary small coal or coke usually employed in the cement mill. Grinding of the two together should then take place. Direct firing by an intimate mixture of the two grades of fuel gives a far greater and steadier heat than firing first with good coal or coke and then with poor grade colliery smudge.

Refuse from Tipple Picking Tables

Cement manufacturers are almost certain to be offered this substance if they are on the market for cheap fuels for employment in cement factories.

Here again, however, samples may be palmed off on the buyer which are utterly worthless. A considerable amount of judgment is necessary in purchasing this junk, however cheap it may be.

There are many samples of tipple picking table refuse for sale which contain only about 23 per cent of fixed carbon. This alone need not condemn the refuse; but in all probability attention will be drawn to the fact that such samples frequently contain as much as 19 per cent of volatile matter, in the hope that the material will be bought on that score. Further examination, however, reveals the astounding fact that 46 per cent of incombustible ash is present; and bearing in mind the fact that samples containing as much as half this amount require very elaborate treatment before they become suitable for use as fuel for cement factories, one cannot help wondering why firms waste their time in offering such samples to industries for which they are so very unsuitable. In many instances a great point is made of the low moisture content, this being about 8 per cent in the worst samples, but here again vendors fail to grasp the essentialities of composition so far as cement factory fuel is concerned, and do not tell us that the best samples can be put on the market with a moisture content of only one per cent.

The calorific value of useless samples of refuse from tipple picking tables, so far as the cement industry is concerned, is round about 8,000 B.t.u. This is, of course, considerably higher than that of the worst samples of colliery smudge and colliery slurry, but the technical difficulties which removal or reduction of incombustible matter present are of greater importance in this instance than the actual calorific value. The best samples of this refuse so far as fuel for cement factories is concerned have a calorific value of 10,500 B.t.u., and in some few instances a higher figure even than that can be attained.

To get the best results in the employment of refuse from tipple picking tables as cement factory fuel, analysis should reveal the presence of 47 per cent of fixed carbon and 27 per cent of volatile matter. The ash content should be not more than 21 per cent, and the moisture content as low as one per cent. The amount of incombustible matter is reducible very easily in some instances, and with great difficulty in others, by means of endless bands operating in troughs, and endless bands of the open table type. When the material is large, as is the case with some samples, cement mill managers will have little if any difficulty about reducing the ash content to 10 or 12 per cent; but when it is in a finely divided state, the ash may still amount to 15 per cent in spite of repeated passage over the bands already described.

No air drying is necessary in the treatment of this refuse; but after it has been sorted as above mentioned the coarser forms should be nutted and then re-passed over the bands before being mixed with small coal and finely ground with it.

Steam Duff

Cement works managers who can get good samples of steam duff should buy them, as they will find them very useful as a cheap fuel for cement factories. The best samples should show on analysis the presence of 66 per cent of fixed carbon and 11 per cent of volatile matter. The ash content is always high, and when it is more than 20 per cent, which should be regarded as the maximum figure, samples should be declined. The moisture content is always low, but 2 per cent should be regarded as being the maximum, and samples containing more than this should again be refused. The average calorific value of samples of steam duff which are suitable for employment as fuel for cement factories is 11,000 B.t.u., but occasionally a higher figure is obtainable.

Tip Breeze

Cement plant managers should be extra cautious about buying tip breeze for employment as a cheap fuel for cement factories, as there are forms on the market, known collectively as fine tip breezes, which are utterly unsuitable, and which never could be recommended by any fuel experts on account of the fact that they contain nearly 40 per cent of ash.

The best samples of tip breeze for employment as fuel for cement factories show on analysis the presence of 67 per cent of fixed carbon, and roughly 10 per cent of volatile matter, while the ash content should be low, round about 13 per cent; the moisture content is frequently pretty considerable, though a maximum of 10 per cent should be allowed. The calorific value of the best samples of tip breeze from the cement manufacturer's point of view should be round about 10,500 B.t.u.

The modus operandi in this instance consists first of all of air drying the mixture, in order to reduce its moisture content very substantially, and subsequently it is passed through mechanical sieves in order to get rid of the finest material, which sometimes contains the biggest proportion of carbonaceous matter, but more usually contains most of the useless dust. The coarse material should then be sorted on an endless band, and bits of shale, rock, etc., thrown out. Following this the fine tip breeze nuts should be ground with small coal, in the proportion of one part breeze to two or three of good class fuel, and then the combination fired directly, without further treatment.

Washery Waste

Here again many traps may be set for unwary buyers, as regards the purchase of a cheap fuel popularly termed washery waste. Colliery firms are delighted to get rid of this at a nominal charge, but are not too keen to point out to us that some of these yield an evaporative power only equal to about 4 pounds of water per pound of fuel, while many have an ash content of 35 per cent, and others known as "good average samples" reveal on analysis the presence of 25 per cent of incombustible ash. I need hardly say that all these classes of washery waste are utterly useless from the point of view of fuel for cement plants, and the closest examination of every analysis proffered should be made before placing a contract.

Even the best samples of washery waste from the cement manufacturer's point of view show the presence of only about 47 per cent of fixed carbon; but the volatile matter content is quite high, and 17.5 per cent should usually be insisted upon. The ash content should be as low as possible, and all samples containing more than 16.5 per cent should be firmly declined. The moisture content unfortunately is often very high, and even in the best samples 19 per cent may be present. Colliery firms, however, should be requested to reduce this to 12 per cent, as no cement firm wishes to pay freight on fuel of which one-fifth of the total bulk is water. If the colliery firms won't dry the washery waste the cost of this should be deducted when calculating the price per ton. This varies in different districts, and a constant, therefore, cannot be given in the present article. The calorific value of the best samples of washery waste so far as cement factory fuel is concerned should be roughly 9,000 B.t.u., but certain really first rate samples have a greater value, up to 10,000 or 10,500 thermal units.

The modus operandi consists of air drying the washery waste in order to reduce its moisture content still further, following which passage along endless bands of the trough and table types is necessary in order to eliminate incombustible matter as completely as possible. Perforated bands or band sieves may be recommended for the fine varieties, the coarse material being subjected to further scrutiny before it is ground up. Admixture of the washery waste with from two to four times its own bulk of good small coal or coke ordinarily employed as cement factory fuel is recommended, although some authorities are venturesome enough to recommend one part good fuel being used for five parts washery waste, and claim that reliable results have been obtained.

New Silos and Machinery Building for Neville Island Plant

The Rust Engineering Company has been awarded a contract by the Davison Coke and Iron Company for the construction at the Neville Island plant near Pittsburgh of six reinforced concrete cement silos. They will have a storage capacity of 100,000 barrels.

A machinery building to house the cement pumps will also be erected.

Royal Steel Company Forms New Cement Firm in Holland

The Royal Steel Company of Holland is forming a company, the Ymuiden cement factory, capitalized at 1,000,000 florins. A mill with an annual capacity of 100,000 tons of cement will be erected at Ymuiden to extract cement from the slag of the steel mills.

EDITORIAL

Six-and-a-Half Per Cent

SEVERAL times during 1930 the cement industry was given convincing evidence—or evidence that should have been convincing—that things were not so bad. One of these came as a pleasant surprise when it developed that shipments of portland cement in the first five months exceeded shipments of the corresponding period of the previous year.

In spite of the seeming hardships of the second half of 1930, total shipments in the full year just closed are now found to have been 158,744,000 barrels, compared with 169,868,000 barrels in 1929.

After all, that is only 6½ per cent below 1929. Many an industry would be engaged in celebrating the return of prosperity if its volume of business had declined no more than 6½ per cent in 1930.

To cite only a few examples, total construction contracts for building and engineering work in the 37 states east of the Rocky Mountains declined 21.3 per cent in value, according to the Dodge reports. Sales of lime in 1930 by producers in the United States declined 21 per cent in quantity, by comparison with the previous year, and the quantity of lime used in construction work declined 27 per cent. Both steel and lumber production suffer far more than cement production in a comparison with 1929.

Of even more importance is the encouraging outlook for 1931. While only a rash prophet would predict greater cement shipments in 1931 than in the peak year of 1928, there is promise of an upturn as compared with 1930. Shipments have declined for two successive years. Only once before, in the 1913-1915 period, has a decline extended over so long a period.

At the present moment several favorable factors of major importance may be seen. State highway departments are preparing for another big year. Hundreds of millions of dollars are being made available, through bond issues, for construction of municipal improvements. A vast program of federal government work is lined up for construction, and the same is true of a number of large projects of a private or semi-public nature.

With these favorable prospects before it, the cement industry may well forget that 6½ per cent and face 1931 with the determination that the curve of annual shipments shall again be started on its normal upward climb.

The Real Sources of Leakage

DURING the past fifteen months cement company executives have given much of their attention to the task of finding and stopping leaks.

Now the task consists of keeping the leaks stopped, for the elimination of wasteful conditions and practices is always a matter of importance, whether times are dull or prosperous. No permanent gain can result if some of the leaks, once stopped, are allowed to creep back into the organization again.

If the administrative overhead has been reduced through the elimination of needless frills, vigilance will be required to keep others of no greater value from taking their place.

If it has been found that some of the operating departments can get along with fewer men than were formerly employed, watchfulness will be required to prevent a return to the former conditions.

Other sources of leakage are less obvious, but no less costly. For instance, if grinding costs are high because of the use of obsolete methods, failure to make the necessary changes and new installations constitutes the worst kind of waste.

If power is bought from the outside and bills are high, failure to recover the waste heat from the kilns to produce the needed electric power is another source of waste.

The continued use of any mechanical equipment that has been rendered thoroughly obsolete by radically improved equipment constitutes a source of leakage no less than the more apparent ones. These are the real sources of leakage, for they have a continued adverse effect on the cost of every barrel of production.

Operating executives in charge of plants that are in the obsolescent stage must choose between two alternatives. They must choose between modernizing the plant and putting an end to high production costs or struggling along with their present equipment toward the ultimate shut-down.

Courageous Management Wins Profits

THE whole world bid farewell to 1930 with a sigh of relief and a hope for better times ahead; but even in years like 1930 courageous management earns profits.

This assertion can be applied to the cement industry with special emphasis, for in the face of falling demand and lower prices many cement manufacturing companies have finished out the year with a net profit. That alone is a commendable performance, whether the profit in individual cases is larger or smaller than it was in 1929. It is said, in fact, that one large midwestern company will show the best year in its history.

It becomes increasingly clear that the portland cement industry is blessed with courageous management, for no other kind of management could have wrested profits out of a year such as 1930.

Analyze Cement Industry of World

Estimate 1930 Production at 400 Million Barrels—Capacity Grows Faster Than Demand—Future Lies in Special Cements, Better Quality and Lower Production Costs

(From *Commerce Reports*, January 5, 1931)

ON the basis of estimates made by C. F. Stephenson, of the U. S. Bureau of Foreign and Domestic Commerce, covering 1927, and considering increases that have taken place since, the capacity of world cement plants probably ranges in the vicinity of 600,000,000 barrels annually. Of this estimated total, 40 to 50 per cent lies within the borders of the United States. Actual world production may be conservatively estimated at 400,000,000 barrels at the close of 1930.

The major producing countries, in the order of their importance, are the United States, Germany, France, England, Belgium, and Japan. The United States is responsible for approximately 10 per cent more than all the others combined, or more than four times the output of Germany, the second largest producer.

Distribution of Production and Consumption

An interesting fact that has been repeatedly pointed out is that while actual production is greatest in the United States, exports form an exceptionally small part of the trade involved. With respect to consumption, Belgium has a higher per capita export than any other country, and a higher per capita consumption than any except the United States.

Extreme Competition Induced by the Profits

Although applications to industry continue to show growth suggestive of strong correlation to price indexes and progress in other major commodity lines within the United States, price is seemingly the dominant factor when cement consumption statistics are examined, from a viewpoint of either production or export sales.

In Japan, the United States, and the principal industrial countries of Europe, the capacity for production of cement has long greatly exceeded the demand.

In late years, in all countries, the great success of cement manufacture as an industry has become essentially its chief competing factor. Attracted by consistent profits enjoyed by the larger low-cost producer, considerable production capacity has been attained, which has accentuated an uneconomical situation already existing within the industry.

Sale Trends of Producing Countries

In the recent past much of the excess capacity of Japan and Europe has been absorbed by the export markets of the Far East and South America. The demand in the United States has had a rate of increase, in general, only slightly less than the growth of cement plants. In short, the industry within United States boundaries has been afforded a market not vitally dependent upon export trade to carry its surplus. This favoring situation becomes more marked when consideration is given to the relative price, as well as domestic marketing data, for similar European products.

The world export market for cement frequently amounts to about 40,000,000 barrels. By far the greatest proportion is sold to the countries of Latin America, and practically every producing country of the world participates in some degree, with German, Belgian, and English cement leading. Notwithstanding an extremely low export price (in some cases as low as $0.70 a barrel) and favoring ocean freight rates, however, inland transportation rates and incidental expenses have resulted in a consumer cost that in many cases eliminates cement from consideration except where no suitable substitute can be found. It appears to follow that where the demand exists and suitable raw materials can be found, production within a country might be undertaken. Such has been the case in some of the more recently developed plants. Chile, Argentina, Brazil, Peru, and China, have had plants operating with increasing capacity for several years. Fortunately for the exporting countries, the progress and prosperity of the coastal countries of South America has been more rapid than plant construction, so that imports have not been seriously affected until the beginning of the current year.

Apparent Present Trend of Sales

It might be inferred, then, that in so far as portland cement is directly concerned, the present decline in export cement consumption will continue. Considering the tremendous overproduction in nearly every industrial country, with the possible exception of Russia, the prospects for an improved condition do not seem large. Certainly, new and additional plants are being constructed throughout the world, particularly where the rapid development of an area may appear to demand it. In general, therefore, the real future for the industry appears to lie in the development of special types, in the improvement of quality, and in operating conditions which tend to lower price.

Cement Demand for Highway Use

Probably the most important single consumptive demand for the future will be for the extension of highway construction. It seems to be generally recognized that the most satisfactory road is one properly constructed of concrete. Adequate highway systems are gradually becoming of first consideration in the development of areas for industrial or other purposes.

In view of the present world productive ability, it appears probable that capacity figures would be only slightly affected by the most sanguine road-building project either for a single country or for a district involving large yardage figures.

West Penn Attains Much Finer Product

Three-Compartment Compeb Mills Hooked Up with Air Separator—Much Wider Range of Particle Sizes Than Formerly Possible—Factors Affecting Grindability of Clinker

By A. E. HISCOX
Superintendent and Chief Chemist, West Penn Cement Co., West Winfield, Pa.

UNDER the heading of "The Cooling and Grinding of Clinker," in the November (1930) issue of *West Penn Cement Safety News*, the writer discusses in considerable detail the various processes involved in the cooling and grinding of portland cement clinker. In so far as that discussion deals with the grinding of clinker, it conforms with the discussion given here.

Clinker, as it leaves the average kiln, will range in size from dust to pieces two inches or more in diameter. We are fortunate in that very little of our clinker will run over three-fourths of an inch in size. However, all clinker is passed through a set of 54 by 20-inch Traylor rolls, which are so adjusted that the product has a maximum size of one-fourth inch. Reduction to this size avoids the necessity of heavy crushing in the preliminary compartments of the mills. Consequently, repairs on the mill linings are materially reduced. In case of a breakdown of the rolls there is no interruption, as the clinker can be by-passed. Reduction of the clinker to a uniform size results in an increase in the productive capacity of the grinding units about 20 per cent.

Three-Compartment Grinding Mills

Our grinding mills are of the compeb mill type and have three separate compartments. No. 1 mill is of the straight type, 8 feet in diameter and 30 feet long, and has a capacity of approximately 125 barrels per hour. No. 2 mill has an enlarged preliminary chamber, 9½ feet in diameter, the second and third compartments 8 feet in diameter, with an overall length of 38 feet. This unit has a capacity of approximately 200 barrels per hour, and is supported on trunnions equipped with Timken roller bearings. The smaller unit is driven by an 800-hp. synchronous motor and the large one by a 1100-hp., both through magnetic clutches. Clinker is fed to the mills by Schaffer poidometers.

As the clinker enters the preliminary compartment it is pulverized by the abrasion and impact of heavy steel grinding balls. These balls range in size from 4 inches in diameter down to 2½ inches. Between the first and second compartments of No. 1 mill there is a grid type screen, with openings originally set at .0625 inches. As rapidly as the clinker is reduced to the size of the openings it passes on through to the second compartment. No. 2 mill is equipped with a circumferential screen instead of the grid type, the screen opening being .35 inches. Oversize material from this screen is returned to the preliminary chamber for additional grinding while the fines are picked up by scoops and passed to the second compartment.

Only Two Types of Grinding Media

In the second compartment the material is reduced to still finer subdivision. However, a smaller grinding ball is used in this chamber as well as in the third. A long series of experiments has proven that the same size of grinding media may be used efficiently in both the second and the final compartment. It is our practice to use the medium known as the cylinder ball, ⅝ inch in diameter by 1½ inches long, for both the second and third compartments. The partially ground clinker works its way through the second compartment and passes into the third and final chamber through screen plates in the division head. These plates have an opening of 3/16 inch. The pulverizing is completed in the third compartment and the cement passes out through a screen head and a hollow trunnion into the Fuller-Kinyon pumps which convey it to the storage silos.

Each of the separate chambers is loaded with grinding media to approximately 40 per cent of its capacity. Representative charges used for each compartment are as follows:

Compartment	No. 1 Mill	No. 2 Mill
First	16 Tons	28 Tons
Second	27 Tons	38 Tons
Third	24 Tons	29 Tons

For one thousand barrels of clinker ground there will be consumed approximately 115 pounds of grinding media.

As a result of long study, we have found it is only necessary to purchase two types of grinding media, 4-inch steel balls and the ⅝ by 1¼-inch cylinder ball. The large balls wear down gradually but regrading allows us to maintain a uniform mixture of these from 4-inch down to 2½-inch. As the cylinder balls wear down it becomes necessary to screen out all the undersized and broken ones and replace by new stock. Such an arrangement as described above simplifies both the purchase and the use of grinding media.

Factors Affecting Grindability of Clinker

Clinker that has been exposed to atmospheric conditions for any great length of time is often hard to grind. Although the seasoning has undoubtedly softened the material, there is the possibility of so much moisture being present that the clinker may grind less easily than that fresh from the kiln. Hot clinker resists grinding more than cold. This loss in output due to heat may run as high as 40 per cent. Overburning clinker renders it very hard. So much heat may be applied that the clinker is completely vitrified. On the other hand, if it is not thoroughly burned the chemical combinations may be incomplete and an inferior grade of cement produced. It is therefore necessary to find the "middle of the road" in burning so as to avoid these two extremes.

Chemical composition has a decided influence on grinding. A clinker low in percentage of iron oxide will be pulverized more readily than one high in the same compound. The greater the amount of lime or calcium oxide, the less the difficulty encountered in grinding to the required fineness.

The charges of grinding media in a mill should be kept up to the tonnage decided upon as standard. If the ball sizes are simplified, a weekly schedule of charging can readily be followed. Indiscriminate mixing of various types of media will lower the efficiency of a mill. In our laboratory we have made a careful study of different types and sizes, with the result that some sizes and shapes that were regarded as standard for years were discarded.

Reduction of the kiln run of clinker to one uniform size before feeding to the mill will materially increase the output.

The tonnage of clinker that can be handled by any grinding unit is dependent upon the standard of fineness maintained. The laboratory takes samples from the mills at regular intervals. If the fineness is lower than desired, the rate of clinker feed is reduced; if the fineness is greater than needed this rate can be increased.

The Trend of Fineness Requirements

During the last few years the specifications for the fineness of portland cement have steadily demanded the finer subdivision of the clinker particles. Today it is necessary to grind cement to a maximum of 20 per cent retained on the 200-mesh screen.

Of late another criterion of the fineness of cement has come into use—the percentage retained on the 325-mesh screen. A cement that tests 12 per cent retained on the 200-mesh screen will show approximately 24 per cent retained on the 325-mesh.

Repeated tests, however, reveal that even the 325-mesh screen determination has little significance, as it does not throw any light on the relative sizes of particles. Air analysis is now being resorted to and the size of particles stated in terms of microns. The study of particle size in cement is a new and unexpected field. What the results of research now being carried on will be, no one can say. We can rest assured, however, that the increased knowledge will aid us in continually improving our product.

Air Separators

As the demand for finer cement grew during the past few years, it was discovered that there was a limit beyond which it was not possible to go, with straight tube mill grinding. This obstacle brought about the development of the commercial air separator. Air currents were used to separate particles of different sizes. We have now installed at West Penn a 16-foot Sturtevant air separator and have succeeded in getting a range of particle size not possible heretofore.

In conclusion it might be stated that we are at last learning how to grind portland cement clinker efficiently. Larger units have increased output with lowered costs; the properties of different types of grinding media have been discovered; the microscope has been put to work to show us the sizes of particles. The end of our efforts continually to improve portland cement is not yet in sight but progress is steady and sure.

General Electric Develops Plan for Fifty-Weeks' Work in 1931

A stabilization of employment plan whereby employes of the incandescent lamp department of the General Electric Company of not less than two years' continuous service, will be guaranteed fifty weeks' work for the year 1931, was announced recently by President Gerard Swope and was to become effective January 1, upon acceptance by sixty per cent of the eligible employes.

In June of this year President Swope announced a comprehensive plan to minimize the cause and effect of unemployment in the company. The plan provided, first, for the stabilization of employment and, secondly, for the relief of the unemployed. Because of unemployment conditions in apparatus works of the company all employes, beginning Dec. 1, are paying one per cent of wage or salary into the unemployment pension fund. Such collections will be made through the month of December and longer if necessary. Employes of the various lamp works, about 8,000 in number, did not come under the provisions of the plan as announced in June.

Under the conditions of the employment stabilization plan, a week's work shall comprise the normal working hours per week for each division, department, factory or activity as defined by its manager and subject to change by him, but in no case shall it be less than thirty hours' work in any calendar week, except as affected by deductions for holidays, illness of the employe, or through fire, flood, strike or other extreme emergency. Subject to such terms, full payment will be made to employes for 30 hours' work in case of employment for less than 30 hours in any calendar week.

Participation under the plan is optional and will become effective upon acceptance of 60 per cent of the eligible employes of each works and by the individual application of the employe who requests the company to deduct one per cent of his or her weekly earnings and credit the amount so deducted to such employe.

The company reserves the right to transfer employes to other work, where the employe shall receive the prevailing wage for the work, but not for less than the minimum hours guaranteed. This guarantee expires December 31, 1931.

New Working Plan for Kansas Lone Star Plant

A new working plant was launched at the Lone Star cement plant at Bonner Springs, Kansas, recently when it reopened with a one-kiln crew, after being shut down for 15 days.

The number of employes will be determined by the output from only one kiln, and they will work the year around, with no shut-down during the winter. As business increases, additional employes will be added and other kilns opened.

Distribution of Facts Draws Fire

Reprint Giving Data on Excess Cement Mill Capacity Mailed to Investment and Banking Houses — Reader Takes Exception

READERS of the Cement Mill Section of CONCRETE are familiar with its efforts to discourage the ill-advised promotion of new cement plants by professional promoters, especially in localities already overcrowded. On the other hand, CONCRETE has just as consistently urged the modernization of existing plants, to the end that quality may be improved and production costs lowered.

Data Given to Financial Houses

In line with this policy, reprints of an article entitled "90,000,000 Barrels Plus" (including a full-page chart showing the large excess capacity in the cement industry) and an editorial entitled "Still More Cement Mills," both printed in the December issue of the Cement Mill Section, recently were mailed to all important banking and investment houses throughout the United States and Canada. The purpose back of this action was that of placing the facts before the leading financial houses in every community, so that they, in turn, might be in a position to advise prospective investors.

One Reader Takes Exception

A correspondent who read the reprint has taken CONCRETE to task because of the broadcasting of the data contained in it. In the following extract from his letter he sets forth his views on the subject:

> It seems to me, in the first place, that CONCRETE is entirely out of its field when it attempts to regulate the building of cement plants. The real function of a paper like CONCRETE is to print news connected with concrete, cement mills and allied industries, instead of attempting to shut off the building of new plants, when the sole reason given is the large overproduction. Does it not occur to you that a transition period has been reached in the process of manufacturing portland cement? It is quite similar to the situation in the early 90's when there were less than half a dozen portland cement plants in the United States with a combined capacity of approximately one-quarter of a million barrels. At that time there were many millions of barrels of "natural" cement being manufactured. Almost all the portland cement was coming from Europe. In the early 90's new portland cement plants began to spring up and in the next decade practically all the "natural" cement plants in the country were put out of business, due solely to the superior quality of portland cement over "natural" cement. The same transition period is taking place today, with probably two-thirds of all the listed capacity of portland cement represented by plants that are absolutely obsolete and should have been torn down and placed in a junk pile long ago. Many of the kilns representing the listed capacity are 6 by 60 or 7½ by 125 ft., and kilns of that type. The modern cement plant today will have kilns ranging from 300 to 600 ft. in length, a diameter of 11 ft. 3 in. and a soaking zone anywhere from 12 to 15 ft. in diameter. With such kilns a new modern cement is being produced which is as superior to the ordinary portland cement as the ordinary portland cement in the 90's was superior to the old "natural" cement. Under such conditions plants are bound to be built which necessarily will force out of business the old junk piles built anywhere from fifteen to thirty years ago.

No Quarrel with Logical Expansion of Industry

First of all, CONCRETE assures its readers that its efforts toward discouraging what it has called "the ill-advised promotion and construction of new plants" is in no sense directed at the logical expansion of established cement manufacturing plants, or against individuals who are familiar with cement manufacture and know what they are about.

The "ill-advised promotion and construction of new plants," which CONCRETE believes should be discouraged, is particularly the kind that is engineered by promoters who play up local pride or stir up a contest between two rival towns as the means to their end. CONCRETE believes that there are too many groups promoting the building of new cement plants who are entirely unfamiliar with the highly technical character of modern portland cement manufacture. In publishing data of the type to which the above exception has been taken, the publication is merely placing the facts before the industry and in other places where the facts should be known. This is already being done rather effectively by the *Wall Street Journal* and by the *Chicago Journal of Commerce*. It was from the latter publication that the December article on excess capacity was abstracted.

What Is Obsolescence?

CONCRETE feels, also, that parts of the correspondent's letter are fundamentally in error. First, there is the matter of obsolescence. The degree of obsolescence is, of course, a matter that is governed by the point of view, but CONCRETE believes he is much too high with his estimate that two-thirds of the present capacity is represented by plants that are absolutely obsolete. This estimate, it is believed, is based on the erroneous assumption that plants "built anywhere from fifteen to thirty years ago" are operating with equipment that is from fifteen to thirty years old. On the contrary, cement mill equipment has a way of wearing out in five or six years, and many of those older plants have been completely modernized through the periodical replacement of worn-out equipment with new equipment that has been the best available at the time of its installation.

The Real Function of a Business Paper

Another fundamental error in the writer's letter is seen in his estimate of the function of a business paper such as the Cement Mill Edition of CONCRETE. A business paper covering the cement industry which, in 1931, did no more than to "print news connected with concrete, cement mills and allied industries" would not have much reason for existence. That conception of a business paper has long ago been discarded. The Associated Business Papers, Inc., of which CONCRETE is a member, defines the functions and responsibilities of a business paper in a manner that is quite different. Among other things, "it must provide adequate, authoritative expression on all subjects pertinent to its field."

No industry can stand still, the cement industry least of all; but it will be well if the professional promoter turns to other fields and leaves the future development of the portland cement industry to those who understand its problems and its prospects.

First Circular Cement Storage Tanks Pioneered by H. F. Tyler

Built in 1912 at Dewey's Oklahoma Plant—Followed Soon by Similar Installations Elsewhere

By LEWIS R. SIMS

In the January issue of CONCRETE a tribute was paid to H. F. Tyler, first vice-president of the Dewey Portland Cement Co., for his far-sighted and enterprising step in installing and ironing the kinks out of the closed-circuit wet grinding process of preparing cement raw materials.

It is probably not generally known that this same pioneering spirit is responsible for the present widespread use of the circular concrete tank for storing portland cement and its more recent adoption for the storing of dry raw materials.

The many disadvantages of the rectangular type of storage bin were early recognized but it remained for Mr. Tyler to pioneer the change.

Circular bins had long been in use for storing grain, but its adoption for storing portland cement was looked upon with skepticism by those within the industry. As the writer recalls it, the principal stumbling block in the pathway was the possibility of heavy avalanching when withdrawals had gouged out large holes in the mass. It was felt that heavy slides would produce large indeterminate stresses. After considerable investigation of the subject it was decided to test an installation, so in 1911 Dewey Portland contracted with the Macdonald Engineering Co., of Chicago, for the erection of four tanks 32 feet in diameter and 80 feet high, with a logical arrangement of interstices.

Completion was accomplished in 1912, and so satisfactory was their operation that general adoption followed almost immediately. This first installation at Dewey, Oklahoma, was built with ten-inch walls having a very high steel ratio.

Superior Portland Cement Incorporated, at Concrete, Washington, started the second installation before the tanks at Dewey had been thoroughly tested, and even higher factors of safety were used. The walls there were made twelve inches thick, and the reinforcing began with two rows of two-inch round bars staggered on six-inch centers.

Bureau of Mines Analyzes Cement Situation

While cement shipments are falling off, plant capacity is steadily increasing, and there is no indication of any recession in the growth of plant capacity, the Bureau of Mines points out.

Minor fluctuations occur in plant capacity from month to month, while stocks and shipments show marked seasonal fluctuations which are characteristic of the industry. Stocks of cement in 1930 were considerably higher than for the corresponding months in 1929. Shipments in 1930 show a moderate decrease from the 1929 figures. Shipments for the first 10 months of 1929 total 152,264,000 barrels and for 1930, 144,272,000 barrels.

The facts brought out most forcibly in the Bureau's survey of the situation are: (1) A rapidly increasing plant capacity with no indication of a falling off in the rate of increase; (2) a moderate falling off in shipments; (3) a moderate increase in stocks on hand; and (4) a pronounced and steady decrease in price per barrel. Future conditions that may develop as a result of this combination of circumstances demand the earnest consideration of every cement plant operator, the Bureau concludes.

The foregoing facts are brought out by supplementary tables and charts which have been made a part of the Bureau's regular monthly statement giving cement statistics for October. Copies of the statement may be obtained upon request addressed to the Bureau of Mines.

Penn-Dixie Plant Resumes

Plant 4 of the Pennsylvania-Dixie Cement Corporation, at Bethlehem, Pennsylvania, resumed work shortly after the first of the year, having been idle since November 14.

New Dealer Marketing Plan is Dropped

Word reaches CONCRETE as it goes to press that the new cement marketing plan has been discontinued by at least two cement companies as a result of the dissatisfaction said to have been caused by it.

The Universal Atlas Cement Company, Chicago, issued an announcement, addressed to dealers, to this effect on January 23. The Medusa companies have also announced the discontinuance of the plan adopted in November.

Two other firms, with offices at Chicago, when reached, indicated that no change had been made.

The Universal Atlas announcement states, "The new marketing method announced by us November 13, 1930, has caused so much dissatisfaction that it is hereby discontinued.

"Our sales policy continues exactly as it was before announcement of the new marketing method.

"Herewith is quotation giving our price, terms, and conditions. This price is subject to the usual cash discount only."

Cement Statistics for December

Production Falls 24 Per Cent in Last Month of Year Over Same Month in 1929—Total of Production and Shipments for Year Show Moderate Decreases

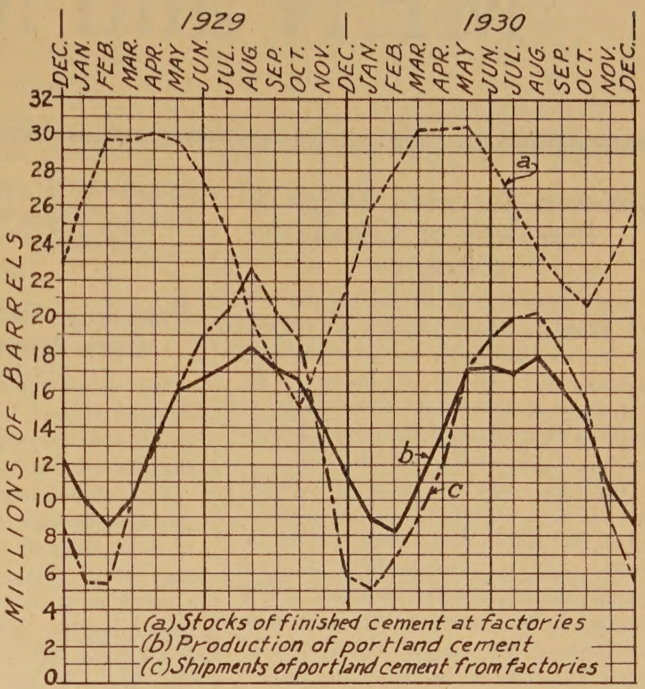
	1929	1930	Increase or Decrease(—) Per Cent
Production, December....	**11,215,000**	8,480,000	—24.4
Shipments, December	**5,951,000**	5,688,000	—4.4
Stocks at end of Dec.......	23,538,000	**25,848,000**	9.8
Total production for year.	**170,198,000**	160,905,000	—5.7
Total shipments for year..	**169,437,000**	158,744,000	—6.5
No. of plants reporting'	165	165	....

NOTE: IN ORDER THAT THE READER MAY KNOW THE TREND AT A GLANCE, THE HIGHER FIGURE, WHETHER FOR EITHER YEAR, UNDER ANY CLASSIFICATION, APPEARS IN SLIGHTLY HEAVIER TYPE.

Relation of Production to Capacity

(Figures represent per cent)

	—December—		Nov.	Oct.	Sept.
	1929	1930	1930	1930	1930
The month	**51.5**	38.2	51.7	65.4	75.7
The 12 months.....................	**66.4**	61.5	62.6	64.2	65.2



Production, Shipments, and Stocks of Finished Portland Cement, by Districts, in December, 1929 and 1930, and Stocks in November, 1930

District	Production—December 1929	Production—December 1930	Shipments—December 1929	Shipments—December 1930	Stocks at end of month 1929	Stocks at end of month 1930	Stocks at end of November, 1930*
Eastern Pa., N. J., and Md..................	**2,479,000**	1,939,000	1,366,000	**1,469,000**	**5,193,000**	4,991,000	4,521,000
New York and Maine............................	**731,000**	716,000	294,000	**364,000**	1,555,000	**1,748,000**	1,395,000
Ohio, Western Pa. and W. Va.............	**940,000**	769,000	**511,000**	467,000	3,035,000	**3,587,000**	3,285,000
Michigan	**1,008,000**	614,000	**246,000**	245,000	2,434,000	**3,091,000**	2,722,000
Wis., Ill., Ind. and Ky..........................	**1,445,000**	984,000	**429,000**	394,000	2,943,000	**3,512,000**	2,922,000
Va., Tenn., Ala., Ga., Fla. and La.......	**905,000**	680,000	**821,000**	648,000	1,641,000	**1,799,000**	1,767,000
Eastern Mo., Ia., Minn. and S. Dak.....	**993,000**	906,000	273,000	**337,000**	**2,595,000**	2,503,000	1,934,000
W. Mo., Nebr., Kans., Okla. and Ark.	**976,000**	700,000	**529,000**	367,000	1,459,000	**2,095,000**	1,763,000
Texas	**593,000**	392,000	**450,000**	362,000	**813,000**	799,000	769,000
Colo., Mont., Utah, Wyo. and Idaho..	**84,000**	34,000	**81,000**	46,000	**456,000**	323,000	335,000
California	**913,000**	531,000	**813,000**	755,000.	**947,000**	876,000	1,100,000
Oregon and Washington..........................	148,000	**215,000**	138,000	**234,000**	467,000	**524,000**	543,000
	11,215,000	8,480,000	**5,951,000**	5,688,000	23,538,000	**25,848,000**	23,056,000

Production, Shipments, and Stocks of Finished Portland Cement, by Months, in 1929 and 1930

Month	—Production— 1929	—Production— 1930	—Shipments— 1929	—Shipments— 1930	Stocks at end of month 1929	Stocks at end of month 1930
January	**9,881,000**	8,498,000	**5,707,000**	4,955,000	26,797,000	**27,081,000**
February	**8,522,000**	8,162,000	5,448,000	**7,012,000**	**29,870,000**	28,249,000
March	9,969,000	**11,225,000**	**10,113,000**	8,826,000	29,724,000	**30,648,000**
April	**13,750,000**	13,521,000	13,325,000	**13,340,000**	30,151,000	**30,867,000**
May	16,151,000	**17,249,000**	16,706,000	**17,224,000**	29,624,000	**30,891,000**
June	16,803,000	**17,239,000**	**18,949,000**	18,781,000	27,505,000	**29,364,000**
July	**17,315,000**	17,078,000	**20,319,000**	20,153,000	24,525,000	**26,289,000**
August	**18,585,000**	17,821,000	**23,052,000**	20,299,000	20,056,000	**23,824,000**
September	**17,223,000**	16,124,000	**19,950,000**	18,083,000	17,325,000	**21,889,000**
October	**16,731,000**	14,410,000	**18,695,000**	15,599,000	15,381,000	**20,697,000**
November	**14,053,000**	11,098,000	**11,222,000**	8,784,000	18,213,000	***23,056,000**
December	**11,215,000**	8,480,000	**5,951,000**	5,688,000	23,538,000	**25,848,000**
	170,198,000	160,905,000	**169,437,000**	158,744,000	....	....

*Revised.

MEN and MILLS

Notes from the Field

Johnson Succeeds Tagge as President of Canada Cement

J. D. Johnson was elected president of the Canada Cement Company on January 9. He was previously vice-president and succeeds A. C. Tagge, who announced his retirement at a meeting of the board of directors held following the annual general meeting of shareholders on that day.

Mr. Tagge, who will remain as a director, has been associated with the company for many years. From 1909 to 1916 he acted as general superintendent, when he became assistant general manager, which position he held until 1927. He was a vice-president of the company from 1921 to 1927. That year he became president.

McCourtie Discloses Plan to Leave Estate to Home Town

Future citizens of Somerset, Michigan, will have no city taxes to pay and will be provided with free schools and hospitals as the result of the generosity of a multi-millionaire cement manufacturer.

W. H. L. McCourtie has recently made public his plans to leave the town, his birthplace, the residue of his estate. Mr. McCourtie is president of the Trinity Portland Cement Company, Dallas, Texas.

New Hawkeye Building

The Hawkeye Portland Cement Company during December began the erection of a combination office, storeroom and machine shop at the quarry located at Earlham, Iowa. The building will be ready for occupancy March 1.

Reagan Houston New President of Republic Cement

Reagan Houston was elected president and director of the Republic Portland Cement Company, San Antonio, Texas, at a meeting held there January 6. He succeeds J. H. Smith, who died recently.

Wellston Plant Has Recreation Quarters for Workmen

Announcement has been made by Jack Diefenderfer, superintendent of the Superior, Ohio, cement plant of the Wellston Iron and Furnace Company, of the installation of a recreation hall for plant workmen. Among the equipment are pool and card tables.

Petoskey Sales Representatives Meet at Jackson

The annual meeting of the Petoskey Portland Cement Company sales representatives was held at the company office at Petoskey on December 29 and 30.

Those from out-of-town were John S. Ames, of Traverse City; R. D. Bradshaw, of Royal Oak; R. P. Bremner, of Milwaukee; F. A. Cook, of Escanaba; M. L. Council, of St. Joseph; B. R. Downey, of Grand Rapids; William C. Bathurst, of Minneapolis; Rollin J. Manser, of Appleton, Wis.; Kenneth Thompson, of Saginaw; V. Van Brocklin, of Grand Rapids; Eugene B. West, of Milwaukee, and Norman R. Wright, of Chicago.

Graham Heads New Bessemer Purchasing Department

K. L. Graham has been appointed purchasing agent for the new central purchasing department established on January 1 at Bessemer, Pennsylvania, by the Bessemer Cement Corporation.

He has been connected with the Peerless Cement Corporation in the same capacity and will continue as general purchasing agent for both.

Wellston Electrician Sustains Double Fracture of Leg

Earl Canon, electrician at the cement plant of the Wellston Iron and Furnace Company at Superior, Ohio, is confined to his home as a result of injuries sustained while helping to truck a load of mortar. Canon suffered a double fracture of the right leg.

Babb Shows Rotarians Cement Manufacture Film

Howard Babb of the Universal Atlas Cement Company was in charge of a showing of a motion picture film on cement manufacture before the Shelbyville, Indiana, Rotary Club on January 8th. He is southeastern representative of the company.

Electrical Department Bowlers Victorious in Superior Cement Tournament

The electrical department bowling team of the Superior Portland Cement, Incorporated, has won the intraplant ten-pin tournament and were feted recently at a dinner by the losing teams.

The five-pin tournament is now under way and the winning team of this tournament will be the guests of the losers at a theater.

Cement Companies Present Generous Bonuses to Employes

Employes of the Lone Star, Crescent, Manitowoc, and Northwestern States cement companies were among those to receive Christmas bonuses.

The Lone Star companies paid employes 10 per cent of their annual salary, instead of five as last year.

Two per cent of an employe's wages or salary during the past year was given to him by the Crescent Portland Cement Company. The Manitowoc company paid a similar bonus.

The Northwestern States company distributed more than $30,000 among its 350 employes, while the 235 employes of the Dewey Portland Cement Company were presented with a total of $21,000.

First Aid Trophy-Holders Prepare for 1931 Meet

The First Aid team of Superior Portland Cement, Incorporated, Concrete, Washington, holders of the trophy for the Northwest Cement Manufacturers, are preparing for the 1931 First Aid Meet.

It is anticipated that the meet will be held at Portland during the summer.

President Lucas Visits Superior Plant

President E. P. Lucas of Seattle made a business trip to the plant of Superior Portland Cement, Incorporated, at Concrete, Washington, on January 15.

Consolidated Salesmen Meet

Salesmen of the Consolidated Cement Corporation held their annual meeting at Jackson, Michigan, on January 6th.

Taijiro Asano Succeeds Father as Head of Japanese Company

At a special general meeting of the Asano Portland Cement Company in December at Tokyo, Japan, Taijiro Asano was elected to succeed his late father. Ryozo Asano, the second son, was elected vice-president.

Soichiro Asano, their father, was president until his death in November.

Lawrence Stimulates Interest in Plant Among Youthful Visitors

After conducting a group of high school pupils through its Allentown, Pennsylvania, plant on a tour of inspection recently, the Lawrence Portland Cement Company made the offer of a gift to be given the child who wrote the best description of what he saw during the visit.

The paper was also promised publication in the house magazine.

Superintendent Ambler Is Speaker at Products Men's Meeting

Superintendent H. A. Ambler of Superior Portland Cement, Inc., was one of the speakers at the annual meeting of the Northwest Concrete Products Association held at Olympia, Washington, on January 10.

Monarch Cement Men Form Basketball Team

The entire plant of the Monarch Cement Company at Humboldt, Kansas, is backing the plant's new basketball team, the Monarch Four, composed of the following: F. A. Hoover, P. B. Fegley, Earl Stack, and Paul Howard.

The quartette has established a good record already and has appeared before conventions and been heard over the radio.

The Monarch team of a year ago won several district tournaments and was entered in the N. A. A. U. tournament at Kansas City in the spring but was beaten in the semi-finals.

Eckert Leaves Lehigh

R. T. Eckert has left the service department of the Lehigh company at Chicago to join the Makins Sand and Gravel Company of Oklahoma City, Okla.

President Wulf of Monarch Returns from Trip

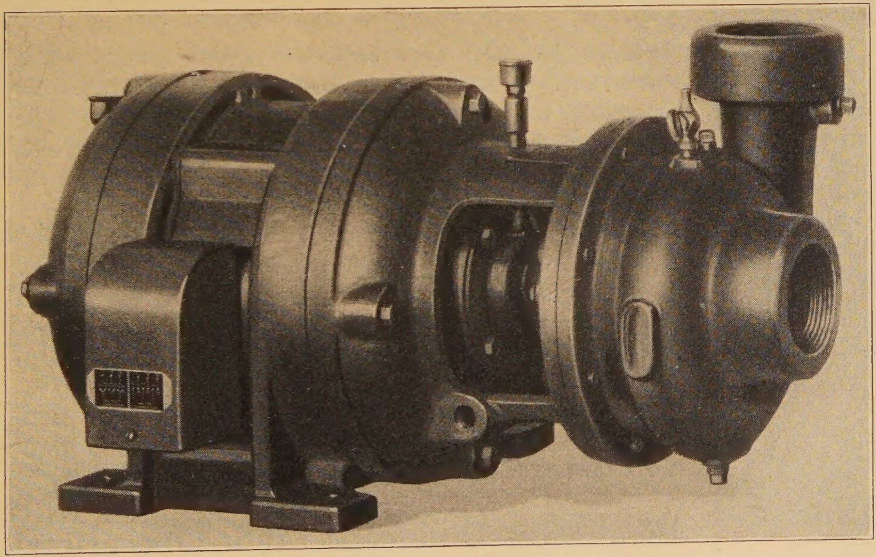
President H. F. G. Wulf of the Monarch Cement Company, has recently returned from a European trip of two months.

Mill Equipment

Allis-Chalmers Extends Sizes of Centrifugal Pumps

Allis-Chalmers Manufacturing Company announces an extension to cover three new sizes in its line of "SSU" centrifugal pumping units of single-shaft, two-bearing design, which now includes ratings from 30 to 500 g.p.m. for heads under 100 feet. Recent adoption of total enclosure of motor housings on the pump end of these units and the use of totally enclosed fan-cooled motors, if necessary, permits their use for severe service conditions.

"SSU" pumps are designed especially for heads heretofore not adequately covered by a low-price, guaranteed, high grade pump.



Synchronous Motors for Starting Under Load

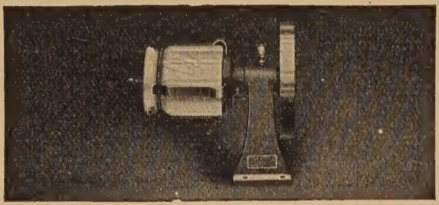
In addition to its high efficiency and excellent power factor characteristics, the adaptability of the salient pole synchronous motor to certain low speed drives, which in many industries represent a major portion of the total plant load, has long since established it as the most desirable type of motor for these drives. However, the driven machines often must be started under load; and, heretofore, the chief objection to the synchronous motor has been its inability to develop the necessary starting and pull-in torques without incurring excessive current inrush or the use of an intermediate mechanical starting device, according to R. S. Wright, industrial engineer.

To fulfill the need for a highly efficient and mechanically simple salient pole synchronous motor providing the necessary starting and accelerating characteristics, the Westinghouse Electric and Manufacturing Company has developed a motor known as the Simplex. This motor has starting and accelerating characteristics similar to a wound rotor induction motor, which have been obtained without sacrificing the desirable running performance inherent in salient pole synchronous motors, it is stated. Both the motor and its controller are designed for operation in extremely dusty locations.

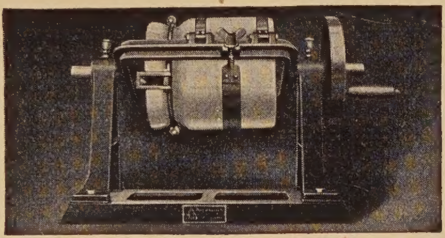
The ordinary cage type damper winding in the pole heads is replaced with a phase connected damper winding. The ends of this winding are brought out to slip rings permitting the use of a variable external starting resistor similar to that used with wound rotor induction motor. This resistor is automatically cut out, in steps, by the controller, and when synchronous speed is approached the direct-current excitation is applied and the motor synchronized. This motor, unlike the synchronous-induction type, utilizes standard excitation voltages of 125 or 250 volts D.C. and requires low exciter capacity comparable to corresponding ratings of low torque design.

Several installations have been made during the past year. At one cement plant in New York state four 300 h.p., 138 r.p.m. motors are driving tube mills and one 350 h.p., 400 r.p.m. motor is driving a preliminary grinder. In eastern Pennsylvania two other installations are in operation.

Laboratory Apparatus for Cement Testing



3674 MILL—Pebble, Single Specimen Type, hand or pulley driven, for grinding or mixing small quantities of substances without contaminating them in any way with metal. The porcelain jar is 5.2 by 5.7 inches and has a dry capacity of ¼ oz. to 1½ lbs. (taking sand as a unit) or a wet capacity of 1 quart. The pulley is 9 by 1 inches and requires 1/12 horsepower when motor driven. Should be operated at 80-120 r.p.m. Complete with 2 lbs. of selected flint pebbles **$16.00**



3682 MILL—Pebble, Assay Type, hand or pulley driven, for grinding or mixing chemicals, enamels, minerals, ores, paints, etc., without contaminating them with metals. The porcelain jar is 8.75 by 9.6 inches and has a dry capacity of 1 oz. to 5 lbs. (taking sand as a unit) or a wet capacity of 1 gallon. The pulley is 9 by 1 inches and requires 1/12 horsepower when motor driven. Should be operated at 55-75 r.p.m. Shipping weight 125 lbs. Complete with 8 lbs. of selected flint pebbles **$35.00**

3683 MILL—Pebble, as above but with tight and loose pulley **$37.00**

For a complete listing of Cement Testing Apparatus and Chemical Laboratory Apparatus refer to Catalog C. Write for a copy if you do not have one.

THE CHEMICAL RUBBER CO.
Laboratory Apparatus and Chemicals
West 112th Street and Locust Avenue
Cleveland, Ohio

Seeks to Halt Northwestern States' Reorganization Plans

Legal action seeking to halt the merger of the Northwestern States Portland Cement Company, Mason City, Iowa, with the recently reorganized Northwestern States Portland Cement Company of Iowa is reported to have been taken by a dissenting stockholder. According to reorganization plants approved by stockholders at a meeting on December 16, the present West Virginia corporation would be replaced by the new Iowa company.

F. A. Ontjes, local attorney, is reported to have filed a petition asking that an injunction be issued restraining W. G. C. Bagley, F. J. Hanlon, Hanford MacNider and the Northwestern States Portland Cement Company of West Virginia from transferring the assets of the cement company to the Northwestern States Portland Cement Company of Iowa.

The petition states that Ontjes owns 100 shares of common stock of the West Virginia company, which has a par value of $100 and that under the proposed reorganization plan four shares of common stock in the Iowa corporation of no par value are to be issued in exchange for one share of the stock, it is reported.

It is claimed that the company has no right to complete the reorganization without the unanimous consent of the stockholders, and that it has no right to abridge the present corporate contract of the West Virginia corporation.

Duluth Plant Attains Capacity Operation in 1930

The 100 per cent mark in capacity operation, the highest in nearly four years, was reached by the Universal Atlas Cement Company plant at Duluth, Minnesota, during 1930.

About 350 men were employed at the plant, which started early in April to take on additional help in anticipation of a record business during the summer. The crews were increased gradually until the middle of June, when full capacity of the institution was reached, according to Ray S. Huey, superintendent.

Unusual demand for cement for public highway construction work all over this area is given by Mr. Huey as the reason for the capacity operations at the Duluth plant. The territory served by the local company includes Minnesota, North and South Dakota, Northern Wisconsin and Upper Michigan.

The clinker was the first to operate at full blast early in April, while work in the finishing mill increased gradually throughout the spring and early summer months.

Ideal Pays Dividend; Plant Operations Approach Capacity

Payment of the regular quarterly dividend of 75 cents a share was made by the Colorado Portland Cement Company, Denver, on December 31.

The plant at Portland reopened on Monday, January 12, employing three shifts daily and operating at a close-to-capacity figure. A fully normal year in production is anticipated.

Operation is already in progress at the Boettcher, Colorado, plant of the company.